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ABSTRACT

This summary of issues addressed at the conference identifies 10 important themes: (1) the nature of interactivity, and whether linear presentations are obsolete; (2) what can be done with all the imagery made possible with videodisks and the sounds enabled by compact disks, and whether any of this is really new; (3) whether emotional presentations are appropriate to education, or whether technology efforts should be used primarily to present "factual data" in educational settings; (4) whether the central task in the design of educational presentations is to link large amounts of information or to tell stories, and what balance is required between directed searching and browsing paradigms; (5) what will be required to make presentations now quite familiar in research laboratories available to the general community, and why it is taking so long; (6) what we know from cognitive theory that we can use in designing with new multimedia interface systems; (7) how multimedia educational "stations" will fit into schools if they do fit in; (8) how a language to describe the "experience" of a technology-based presentation can best be developed; (9) whether there will or should be a standard interface to multimedia experiences, and what the appropriate metaphor for this interface would be; and (10) whether the results will be significant educationally, entertaining, or both, when you combine the traditions of movie-making, graphic design, computer education, encyclopedia development, text publication, public television, computer workstations design, classroom teaching, library organization, entertainment, and psychology. (EW)

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Multimedia in Education

Summary Chapter

Kristina Hooper
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"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

As the old saying goes, "you had to be there." The June Conference on Multimedia in Education, on which this book is based, was an exciting affair. We talked about more issues than I can even recall, all of which seemed central at the moment to the main topic. We discussed issues that had been raised years ago—hypertext, augmentation of human intellect, the opportunities of videodiscs in an interactive environment—wondering once again why these notions hadn't already "taken off." We mused about past projects and future plans. And we decided that "now is the time" for the multimedia revolution, and that among all of us in the group we had the insight and perspective to "pull it off" ("it" being a combination of marketing, educating, designing, computing, visualizing, cognizing, saving the world, and making money).

And then we all rested, for it was as exhausting as it was exhilarating to engage in all these important ideas and plans.

The chapters you have just read represent the efforts of all the participants after they had rested, after they had taken a step back from the excitement of the moment and come to the task of putting down on paper what they thought were the major issues in this (once again) newly focused field.

Different Perspectives

As you probably have noted, the perspectives of all these people are quite different. Such was the intent of the Conference. For the perspectives of a large number of constituencies—including educators, computer scientists, TV producers and broadcasters, entertainment companies, hardware developers, software designers, dreamers, realists, publishers, engineers, and cognitive theorists—are all required for the successful development of the computer-based multimedia revolution that was addressed in our Conference and that is considered in this book.

The current issues are just how these traditions can merge, and the kinds of experiences that are available once this is done. Interestingly, it is difficult to describe the hoped-for experience from these multiple perspectives. And it is hard to describe the nature of the products that result from these perspectives. They are somewhat like books, but not quite. Sometimes they are more like movies, but then they change in character to become more encyclopedic or interactive. Occasionally, these presentations are compared to educational software, yet the high production values available from optical media (such as sounds and images) make it clear that though these new presentations share "interactivity" with this software, there are great differences that require mention.

In time, we will probably stop describing such experiences according to other models with which we are more familiar, and we will begin to call them by their own names (which are yet to be determined; "multimedia presentations" is only a current, inadequate, working title). In addition, more and more people will focus their activities on this class of experiences, without explicitly acknowledging that the roots of their interests or talents are in computer science, television, or other well-established disciplines. When this happens, we will know that the revolution in interactive multimedia experiences has occurred.

Varied Projects

A major criterion for selection of attendees at the Conference (in addition to a sense of humor and a keen insight on the issues) was that they be involved in specific activities in the general area of multimedia. The reasoning was that to understand this new area one needs to be working directly in it. More centrally, it seems that people have been talking about this general field extensively over the last few decades, without producing many highly visible examples that can be scrutinized and learned from. And it seems like the time has come to deliver on the (excellent) rhetoric, and try to "make it happen" (and along the way find out what "it" really is, as well as to honestly assess whether "it" is worth the effort).

The specifics of the projects with which Conference attendees are involved are typically elaborated in the chapters. However, it is also useful to acknowledge the range of these projects in order to appreciate the generality of the class of presentations and experiences that technologies in the multimedia/computer area allow. It is also a useful exercise to contemplate the concrete examples described apart from all the reasoning described in the chapters; this provides a reality check on the entire multimedia endeavor.

Doug Engelbart's Augmentation System was functioning years ago, providing the core for a research community, enabling collaborative work on complex problems. His current work at McDonnell Douglas is an attempt to reinitiate such work and experiment in the use of technology in communication and problem solving. Norm Meyrowitz's Hypermedia Project at Brown University is clearly about to take off; it is available now to students in a number of classes. Steve Weyer's early work at Xerox for browsing a history text, as well as his work at Atari using the Grolier encyclopedic data base, make explicit just how browsing can be incorporated into the use of large-scale data bases. The NoteCard System, developed by Frank Halasz, is now a product available through Xerox, and a specific example of how linkage systems might be designed.

Larry Friedlander has completed a graphical simulation of theatrical performances on a computer for use by his students at Stanford, and has successfully demonstrated a prototype of a videodisc-based system to explore still and moving images of theaters and performances. Bernard Frischer is moving quickly, with the assistance of UCLA, to produce a travel system for teaching the Classics. And Robert Campbell and Patricia Hanlon have produced an example of the kinds of presentations a teacher might make to a class from available materials related to the *Grapes of Wrath*.

Sam Gibbon at Bank Street College has already distributed a television series and supporting print and computer materials in the area of science and math education (Voyage of the MIMI) and is in the midst of preparing a second series (Voyage of the MIMI II), which will incorporate videodiscs. Tom Anderson has demonstrated his concepts of reuse of physics material very effectively, and is actively involved in productions based on this demonstration.

The CD-ROM Encyclopedia product provided by Grolier is still a major example of a working CD-ROM system; Peter Cook's recent work will clearly expand the capabilities of this product to include more flexibility and imagery. The National Geographic Society is now committed to developments in computer software and extensions of their past optical media efforts in enhancing geographic understanding, as described by George Peterson.

Steve Gano's ideas about personalized imagery are surely providing the basis for a number of systems at Hewlett-Packard, some of which we hope to see in the public eye soon. Similarly, Doug Crockford's version of fun will probably be available to a wide audience soon. And as stated earlier, Microsoft's multimedia encyclopedia demonstration, described by Suzanne Ropiequet, is already highly visible, providing a very useful example of a computer multimedia experience for all of us to examine and enjoy.

Prior to reading this book, one would think there was little in common among Shakespeare, physics, *Grapes of Wrath*, and the Classics. Similarly, television and print publishing may have seemed quite unrelated, as did encyclopedias and entertaining storytelling, broadcast television and personalized imagery production, collaborative work environments and classrooms, and sophisticated hypertext systems and classroom computing. I hope that this book has made it possible for you to see the interconnections of these very different efforts, as well as notice that new technologies can provide augmentation in all these areas, expanding our personal experiences and improving our capabilities (and those of our schoolchildren).

Ten Themes

There are a number of themes that pervade many of the chapters, most of which are the same themes that hallway and dinner conversations focused on at the Conference. Important among these are the following:

1. What Is the Nature of Interactivity? Are Linear Presentations Obsolete?

It is currently quite fashionable to be in favor of interactivity. In a related vein, concepts like "personalization," "browsing," "manipulable," "divergent thinking," "response-contingent displays," and "discovery learning" have gained great mileage in the computer education revolution. And this is only appropriate.

The computer (which now comes in many flavors and many different forms, many of which are simultaneously reasonably priced and quite powerful) allows for the realization of dreams that address these concepts in pragmatic terms. We truly can now reflect on our own intuitions of our thought processes—what William James at the turn of the century described as the "perching and flights" of consciousness—and we can dream of machines that can mimic these processes, as well as machines that can assist us in making good use of these mental ramblings.

Yet when one seriously attempts to design "interactive experiences" that incorporate the aforementioned concepts, it becomes less and less clear just what we mean by the word "interactive" and whether or not we are all talking about the same thing. More critically, it becomes unclear whether interactive necessarily implies something that is good (and conversely that linear presentations are necessarily bad).

Anyone who has looked at run-of-the-mill computer software or branching videodiscs that continually interrupt the viewer with multitudes of unappealing choices understands that interactivity is not a sufficient condition for a good experience. Similarly, those of us who have sat on the edge of our seats in lecture halls and theaters, enjoying a nonpassive experience even though we have no control of outcomes or opportunity for any interaction, must acknowledge that there really is something to the crafts of rhetoric and storytelling.

Looking at this seriously, it becomes clear that we must start to understand what the most important aspects of interactivity are, and how complex interactivity has to be in order to produce experiences that are qualitatively different from noninteractive situations. We must, for example, have a crisp answer to questions like the following, the answers for which are based on analyses rather than "religion":

> Isn't most of "interactivity" gained by the ability to start and stop, review and preview, presentations?

> Are videotapes then the major innovation in interactivity, not computers?

> Aren't too many choices distracting?

> Isn't the personalization provided by self selection artificial?

> Where does interactivity fit into classic theories of narratives, and of the importance of beginnings, middles and ends in determining the impact of an experience?

> Where is the correct place for the artistic expression of an author in an interactive presentation?

> How can an author create resolution for a viewer in an interactive environment?

> What marks the end of an interactive opportunity?

We must develop a common vocabulary to discuss these questions, including a set of well-defined words to describe agreed-upon concepts, as well as a set of common exemplars to which we can refer in our analyses.

In sum, we need to give up the simplicity of the equations that proclaim interactivity as good and linear presentations as bad. We can then focus on our task of using new technologies to create effective and engaging experiences, taking advantage of all past experiences (in interactive and noninteractive areas) as well as all available media (digital and analog).

(See Chapters by Anderson, Crockford, and Gibbon)

2. What can be done with all the imagery made possible with videodiscs and the sounds enabled by compact discs? Is any of this really new?

Frequently, one is struck with the feeling of having "heard it all before," particularly if one spends much time in the field of education. The pessimistic interpretation of this is that everything is a fad, and that most of what we are hearing lately about new technologies is all hype. The optimistic interpretation is that good ideas stay around, no matter how badly they are handled, and that, eventually, they will garner the appropriate momentum to be "done right."

The idea of using images and sounds in education is clearly age-old, an idea that has been the basis for the development of a range of audio-visual technologies and materials running the gamut from overhead projectors to television, slide shows to elaborate movies. And the notion that "since images and sounds are available cheaply, they should be used in education" has clearly been overworn in the educational community.

Yet the use of multimedia computer presentations to solve problems that cannot be addressed effectively in any other context is extremely appropriate, as well as exciting. This direction of motivation and development—presented often in this Conference—is highly compelling and convincing vis-à-vis the importance of these new AV presentations. What we still need, however, are fully developed examples that make this obvious—to remove this issue from academic argument and let it face the scrutiny of potential audiences. We need examples that make explicit the wide range of ways that sights and sounds can add to educational experiences, and specific evaluations showing how these contribute to the learning process. Our current psychological theories argue that multisensory learning should enhance understanding, though few of the studies available address interactive situations. It will be interesting to find out just what differences these presentations can make when they are under user control.

In doing this it is important, however, to realize that there are a large number of components that will need to be in place if examples are to be effective. The existence of new hardware and new hardware standards—be they CDI or DVI or LVROM or CDROM or Videodiscs—do in fact provide an opportunity not available to even the most talented designer before. For the shear amount of information is at a scale hardly imagined possible before, a scale that makes possible highly textured information environments which very few of us have ever experienced. And the variety of information allowed by this scale of information storage—for music and images in particular—make possible the intertwining of different presentations, presentations that are manipulable, in new and exciting ways.

Similarly, new software tools and new ideas for interfaces in a range of application domains—many of which are described in this book—are surfacing frequently of late, many of these offering direct access to information by teachers and other non-computer professionals.

The interactions of hardware, software, and interface innovations can provide for some longlasting and solid changes in educational environments. Changes in scale of information, in the tools for information manipulation, in the cost of widely distributed data bases, and in the "appearance" of information, promise revolutions in the human processing of information; education can focus on human thought and thoughtfulness in a range of media, and defocus from the memory of textual facts as the current very new potentials are realized.

(See Chapters by Campbell/Hanlon, Friedlander, and Anderson)

3. Are emotional presentations appropriate to education? Or should technology efforts be used primarily to present "factual data" in educational settings?
At the Conference, there were interesting arguments presented for both sides of this issue. A number of people couldn't believe that others thought emotions were inappropriate and manipulative in the classroom. They argued that emotions are already present in classrooms, and that emotional involvement is critical to make materials relevant to students and to allow any depth of understanding or interest in a topic.

People on the other side of this argument insisted that emotional manipulation of students was "unfair" and inappropriate to the pedagogical enterprise. They found the techniques of the theater and the movie screen highly dangerous in a learning environment; they found the use of music to increase the impact of a political message very unsettling, for example, as they did the theatrical embellishment of a personal discussion/argument portraying controversies. Typically, these people argued that the task at hand, for them anyway, was not to polarize arguments or to use readily available multisensory techniques to arouse and convince. Instead, their task was to accumulate available data and to provide tools so that people could access these.

It is unclear which approach is appropriate. It is clear, however, that as multisensory presentations and tools for their organization are made available by new technologies, people will need to learn to use them and to interpret them, much as they have already done for textual presentations. It is also clear that there will be many controversies about the appropriate use of these technologies in educational institutions (which is not so surprising).

4A. Is the central task in the design of educational presentations to link large amounts of information? Or is it to "tell stories"? Should presentations emulate libraries as reference centers or classrooms (as teaching centers)? Is there a significant difference between encyclopedias and textbooks and TV documentaries and novels and lectures?

4B. What balance is required between directed search and browsing paradigms? Can one count on individuals to bring their own questions and research strategies to their tasks, or must the technological environments provide these?

A number of the presentations at the Conference focused on hypertext systems, systems that enabled the linking of various sorts of available data. Similarly, a number of these presentations dealt principally with encyclopedic presentations, presentations deliberately designed to put a very broad range of information "at the fingertips" of the viewer.

These emphases are extremely exciting and are realistic given technological advances, including general extended memory and increased speeds of processing, as well as advances in software design and existing and expected advances in knowledge representation.

People often paused at the Conference to consider this approach in some detail, however, remembering that there are already large amounts of data available that they don't use very often. Also, reflecting on how they do their own work, they remembered how particular situations and compelling stories and people had led them to their profession, and that these same elements continued to motivate them in their activities. And they began to discuss just how poorly prepared most students are for schooling, and how few of them seem interested in anything.

In many conversations people then argued that even the most well presented "linkage map" would not be enough to engage learners' interests, that it was very important to provide "motivating overviews" and "engaging situations" to people so that moving through these webs of information would be compelling. And it was suggested that this was the prime opportunity of multimedia presentations that should not be ignored. Similarly it was argued that the "nodes" of a linkage system should frequently be highly engaging, often providing elements of surprise and humanness in the presentation of both factual and conceptual data. The argument was that cognitive activities and affective activities are not mutually exclusive, and that in fact affective presentations were not mere accompaniments to "serious presentations" but were in fact their very essence.

In other conversations people argued that the first task was the provision of large data bases, principally of existing materials, and that the incorporation of new media presentations and of affective elements could be a task at a later time, after this large task was accomplished. Similarly arguments were made that suggested that systems should be modeled on motivated individuals first, that the study of these individuals could be of the most help in the design of initial systems. As the proficiency of systems increased, they could be modified to account for the generation of initial curiosity.

The general sense of the Conference, and of the chapters in general, is that these different approaches are highly compatible, and that on reflection, probably both are critical for success of any system. What was also acknowledged is that some people will work on systems that emphasize one approach, given their beliefs and others will work on the other. Optimally at some point, there would be a merging of approaches; designers would learn from the successes of each approach and incorporate them in new examples.

(See Chapters by Weyer and Meyrowitz and Thought Piece by Frischer)

5. What will it require to make the presentations now quite familiar in research laboratories available to the general community? Why is it seeming to take so long?

Doug Engelbart's work in the general area of "augmentation of human intellect" was very nicely demonstrated in the 1960s in his SRI Laboratories. He organized a community of workers who used a system to keep track of itself. He demonstrated hypertext systems and systems for collaborative activities. He developed the mouse (as well as a range of other input devices) and showed how they could be used. He set up working videoconferencing systems, with computers as central elements.

A lot of this work was followed up at Xerox PARC, as systems were developed that combined text and graphics, and that showed the advantages of an object-oriented programming language (Smalltalk). Interfaces were developed that made the powerful computing resources accessible to users, including programmers of these new systems and individuals involved in education.

J.C.R. Licklider and Craig Fields extended the multimedia character of work that focused on human-usable computer systems in their ARPA funding programs. Negroponte's Architecture Machine Group projects were extremely important for this class of activities. The Aspen Project, for example, made clear that videodiscs could be used under computer control to do things that were never before possible—in this case, the apparent travel through a town. The Movie Manual project provided a specific example of just how text, moving and still images, and sounds could be made available to users under interactive control. The Bicycle Repair Manual provided another example of multimedia projects made possible by the combination of optical media and computers. The "Put That There" demonstration also made explicit just how multimedia input devices—voice and direct, manual pointing—could complement large-screen presentations of data. And the SDMS (Spatial Data Management System) demonstrations made explicit how these different multimedia techniques could be used for "navigation through information space," extending the usability of large data base systems.

Yet even with these explicit examples, multimedia experiences have seemed to be stuck in the imaginations of researchers and in the special environments of flourishing research laboratories. For example, videodiscs generally have been quite unsuccessful in entering marketplaces. Though CD audio has been widely accepted in the marketplace, it is unclear whether CD-ROM will be able to build on this success, or whether computer/CD-ROM combinations (in whatever form) will find tasks beyond reference works that show their potentials.

"The chicken and egg" problem is blamed for a lot of this: if there is no hardware, there will be no applications; or if there is no successful application, there will be no hardware investment; and so forth ad infinitum. Standards issues and multiplicities of hardware options are also blamed; until there is a standard CD-ROM format, investors are uncomfortable in using this medium very seriously given the risk involved. And the general digital vs. analog encoding argument also seems to get in the way of coherent action; computer folks are slow to understand why video is anything more than a nuisance, and video and graphic designers see little motivation to work very hard in cumbersome digital media on short-term projects.

And so the conversations go on in limited communities, and very little gets done that is visible to many people. In addition, given the lack of funding for projects, few people are given the opportunity to take on the challenge of multimedia presentations, and so few are trained in the multiplicity of areas required to address the design of such presentations. Even fewer people are involved in the integration of the huge number of issues that must be addressed and simplified to produce coherent products. More and more potential becomes available—interruptibility, interaction, individualization, consistent interfaces, sounds, images, moving images, dynamic computer graphics—and still there are few success stories.
No one will probably ever know why this is all taking so long, though clearly we all have our pet hypotheses. (My pet notion, incidentally, is that our culture fundamentally does not know much about the personal manipulation of information, particularly sound and image information; we are consumers of complex media, but not generators. This provides a great block in "convincing people" of the worthiness of multimedia presentations; it also results in a limited set of experiences on which designers in this new media can draw.)

What is important is that conferences like our June Conference and documents like this book keep trying out the ideas again and again, gathering momentum for some great successes. For indeed, the potential is certainly sitting there awaiting our cleverness.

6. What do we know from cognitive theory to mold our efforts in designing with new multimedia interactive systems?
Fundamental to the entire field of cognition is the finding that unless people engage a task, they will not learn from it. William James pointed this out at the beginning of this century, and research over the last 20 years has provided elaborations of this basic point.

The interactive nature of the multimedia presentations discussed as well as the emphasis on browsing modes will encourage active involvement by users, and therefore, it should enhance learning. Interactions with high-quality sounds and images will be unique in these presentations; more traditional media, including most existing computer software, simply do not provide learners with access to changeable images and sounds. This capability should enhance learning in ways we have yet to anticipate.

Another fundamental finding is that materials that are rich in sensorial content—especially visual displays—are quite effectively remembered. Moreover, the use of visual materials in learning situations—diagrams as well as photographic images—has been shown to enhance learning consistently.

Finally, the entire investigation of knowledge representation—in computer representations as well as in mental models—emphasizes the importance of the interlinking of conceptual materials, something that is a major focus in work on hypermedia as well as simpler hypertext systems. Though we are still naive in matters concerning how users will interact with capabilities for the interlinking of materials, as well as with materials that are presented to them in interlinked contexts, it seems that this approach to the presentation of materials should make explicit to learners the importance of interrelationships of ideas, and therefore enhance learning. These experiences can then emphasize "metacognitive skills," which are showing themselves again and again in basic research investigations to be critical for important learning.

And so the basic research in cognition supports the notion that multimedia presentations should be highly effective in learning.

From a slightly different perspective, multimedia presentations will allow cognitive researchers to study multisensory and interactive learning in ways that have been prevented in the past, given technological difficulties in image and sound presentations as well as the lack of tools for observing complex user responses. And so we can look forward to some valuable interactions between the field of cognition and multimedia approaches, each enhancing the other.

(See Chapters by Anderson and Gano)

7. How will multimedia educational "stations" fit into schools? Or will they?

Schools will be required to invest in new hardware in order to deliver the multimedia experiences discussed in this book. This obstacle will prove to be extremely large for some school districts, whereas it will be minor for others. Recent histories of computer purchases in schools suggest optimism; schools will find new ways to finance hardware when it is shown that the materials delivered with these technologies are important to their business of teaching and learning.

In addition, teaching staffs will need to adjust their methods of presentation in order to take advantage of multimedia presentations. Though experiences with audio-visual materials and with computers will help in this adjustment, there will be clear shifts in emphasis that are suggested by multimedia presentations.

Some of these shifts may be well beyond the curricular guidelines in certain areas, and in advance of the training of individual teachers. In addition, they may well be inconsistent with policies designed to maximize standardized test scores.

The challenge to the multimedia designer in all these regards is to create some applications that are clearly attractive and superior to materials now available. Unless there is a clear superiority demonstrated, there will be no motivation for making substantial classroom changes.

Of course, some teachers will grab hold of new materials and expand them in ways that make it obvious how these new materials both suit standard criteria and expand the opportunities for teachers and students. Clearly, new multimedia presentation designers need to work with these kinds of teachers to encourage these elaborations, and to suit the presentations to classroom realities. Given the pendulum shifts typical of the educational establishment, there is a clear chance that these new presentations can catch on in classrooms. Whether or not they stay in classrooms will be a function of just how good they really are, and just how accessible they are for individualization by both teachers and students.

(See Chapters by Campbell/Hanlon and Gibbon)

8. How can we best develop a language to describe the "experience" of a technology-based presentation? How can we both focus on the hardware/software required for the delivery of this experience and be sure that the experience is the primary motivator and criterion for developments?

The intrigue of new hardware and software developments is highly exciting and compelling. Processors are faster, software is more accessible, and the quality of possible presentations is ever higher. It is extremely tempting to take on these issues for their own sake.

For a different group of individuals, the development of new experiences in the learning and work environment is of paramount interest. New techniques for engaging students as well as engaging one's own mind are central to the interests of this group; a new technology is interesting only because it offers a new opportunity for human thinking/entertainment/etc.

Both perspectives are key to the development of multimedia experiences, as both the technologies and the experiences of users are critical to the success of these presentations. At the moment, the description of the experiences of users seems to be the gaping hole in dialog necessary for co-development of these perspectives. The current approach is the explicit demonstration of experiences that can be directly evaluated. Such an approach typically requires a large technological and financial investment, however, which means that there are not very many public articulations of what the goal is of a multimedia learning environment. Similarly, there are few instances in which these demonstrations are of large enough scale to allow much systematic analysis and testing.

So one is left only with the approach to make as many examples as possible, and to develop some that can be widely available and widely tested. With experience, we can hope to develop a descriptive (if not prescriptive) language to "get better at all this" more systematically.

(See Chapter by Crockford)

9. Will there/should there be a standard interface to multimedia experiences? What is the appropriate metaphor for this interface? Is it the familiar desktop? The understandable spatial map? A task-oriented environment? A set of research tools? A number of construction kits?

The Apple Desktop Interface provides an attractive interface for a wide range of tasks. More critically, it provides a consistent interface for a range of applications, thereby providing users with easy access to many materials without new training for each one. This allows users to focus more quickly on the task and materials at hand, and to use computer tools easily and intuitively. It also allows developers access to a range of conventions of interactions, allowing them to focus on particular applications rather than on new and different interfaces for different tasks. And it provides developers with a constituency that does not require training and explanations from the most basic level.

This interface should therefore serve an important role in the development of multimedia applications; it provides a flexible beginning for a range of user interactions.

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However, as multimedia applications develop, there will clearly be elaborations to this interface, and most probably some extensions that are quite significant. As Friedlander finds in his application, a task-oriented metaphor is central to some educational situations. Campbell and Hanlon, as well as Meyrowitz and Weyer, suggest that a linking framework is key to the use of sophisticated text as well as image and sound browsing and manipulation. Frischer is betting that a spatial metaphor will suit his students' explorations of ancient civilizations. Cinematic metaphors are suggested by Gano's analyses. The Microsoft encyclopedia clearly relies on the metaphor of a book, and the specific organization of reference books. And other metaphors—including sets of research tools, agents, and construction kits—clearly represent other quite viable alternatives for user accessibility to multimedia presentations.

It's currently unclear which of these approaches is most generalizable or most useful. The sense is in fact that until we have examples we won't really know which way to proceed most confidently. Over the next few months and years we will begin to see each of these kinds of metaphors and more and less elaborate interfaces that make use of them. It will be interesting to see which approach—if any—proves to be the favorite for this new class of applications. It will also be interesting to see how the Apple Desktop Interface can stretch to include all of these requirements and approaches.

(See Chapters by Cook, Frischer, and Friedlander)

10. What happens when you combine the traditions of movie-making, graphic design, computer education, encyclopedia development, text publication, public television, computer workstation design, classroom teaching, library organization, entertainment, and psychology?

Can it possibly be boring? Will the results be something new? Will the results be significant educationally? Will they be entertaining? Can they possibly be both?

Will "multimedia experiences" be similar to the experiences of watching a finely crafted movie, writing a heartfelt letter, having a tantalizing conversation, visiting a great library, hearing a fine lecture, attending a symphony, listening to your favorite grandmother, viewing great old newsclips, playing the violin, opening a brand new book you've been waiting for, browsing in your favorite bookstore, effortlessly painting a great picture, reading your favorite magazine, working at a flexible word processor or a spreadsheet, playing a great videogame, winning at Monopoly .....?

Or will they be more like taking exams in school?

It is bound to be an interesting next era in the multimedia applications business!

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Kristina Hooper

Kristina Hooper was trained as a cognitive scientist at Stanford (A.B.) and the University of California at San Diego (Ph.D.). In her research over the last 15 years, she has extended this perspective into the areas of picture recognition, imagery, and visual technologies. Her early activities included a postdoctoral fellowship in architecture, a faculty position at the University of California at Santa Cruz, a DARPA project on geographic information systems that led to a visiting faculty appointment at MIT working on the Aspen Project, and an NSF grant to study the use of computer graphics in teaching calculus.

With the birth of her son Matthew, Hooper moved to the Atari Sunnyvale Research Lab where she became director of R&D, and Matthew became the resident "developmental prototyke." Her daughter Erika was born as the Atari dream ended, and Hooper moved on to Apple's Education Research Group. A new baby girl will be born as this book goes to press. The plan is that this book will help to generate multimedia materials in the near term for these inquiring minds, as well as many others.